Farnell

INSTRUCTION BOOK FOR

'H' SERIES POWER SUPPLY UNITS

FARNELL INSTRUMENTS LIMITED . SANDBECK WAY . WETHERBY . YORKSHIRE LS22 4DH TELEPHONE 0937-3541 . TELEX 557294

Price £1·00

Issue No1 7-74

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SPECIFICATION

MAINS INPUT	0-220-240V, 50-60Hz	H60/25 13A r.m.s. at 240V input (full load) H60/50 23A r.m.s. " " " " " H30/100 28A r.m.s. " " " " "
	0-240V 50Hz only	0-110V version available for H60/25 and H60/50 only.

MAINS VARIATION TOLERATED	±7½%

OUTPUT	Model	Voltage	Current
	H60/25	0-60V d.c.	0-25A
	H60/50	0-60V d.c.	0-50A
	H30/100	0-30V d.c.	0-100A
	Constant voltage or constant current		

LINE REGULATION (output change for a ±7½% mains change)	Constant voltage: less than .01% + 200µV Constant current: less than .01% + 2.4mA
LOAD REGULATION (output change for a zero to full load change)	Constant voltage: less than .01% + 200µV Constant current: less than .01% + 2.4mA
STABILITY	Total drift for 8 hours (after 1 hour warm up period) at a constant ambient temperature is typically:- Constant voltage: less than .02% + 2mV (H30/100) .04% + 2mV Constant current: less than .02% + 5mA
RIPPLE AND NOISE CONTENT at full load (Δf = 10kHz)	Constant voltage: less than 1mV r.m.s. Constant current: less than 10mA r.m.s. (H30/100) 50mA r.m.s.
TEMPERATURE COEFFICIENT typical	Constant voltage: .02% + 1mV per °C Constant current: .02% + 5mA per °C
OUTPUT IMPEDANCE (C.V.) typical	Less than .001Ω from d.c. to 100Hz .01Ω from 100Hz to 1kHz .2Ω from 1kHz to 100kHz 2Ω from 100kHz to 1MHz
MAXIMUM OPERATING AMBIENT TEMPERATURE	50°C
STORAGE TEMPERATURE RANGE	-20°C to +50°C
TRANSIENT RECOVERY TIME typical	Less than 50µS (150µS for H30/100) for output to recover within 20mV of nominal output voltage following a half load change in output current.
COOLING	Forced air cooling by internal fans. Thermal overload protection is fitted

DIMENSIONS in cm. (approx. overall)	Model	Height	Width	Depth	Weight
	H60/25	17.8	48.25	50.8	60kg
	H60/50	17.8	48.25	62.0	79kg
	H30/100	26.7	48.25	53.1	95.5kg

SCHEDULE OF EQUIPMENT

The unit has been carefully packed to prevent damage in transit. When you remove the unit from the box, be sure that you remove all parts and accessories from the packing material.

The complete equipment comprises:-

a) 1 off power supply

b) 1 off instruction book

c) 1 off returnable (otherwise chargeable) packing case

Note:- In the event of damage in transit or shortage in delivery, separate notices in writing should be given to both the carriers and Farnell Instruments Ltd., within three days of receipt of the goods, followed by a complete claim within five days. All goods which are the subject of any claim for damage in transit or shortage in delivery should be preserved intact as delivered, for a period of seven days after making the claim, pending inspection or instructions from Farnell Instruments Ltd., or an agent of this Company.

INTRODUCTION

The Farnell 'H' series are 'heavy-duty' regulated d.c. power supplies giving either constant voltage or constant current output. Changeover from one mode of operation to the other is automatic and the point at which changeover takes place is continuously adjustable by front panel controls. Indication of output is provided by two front panel meters, one measuring output voltage and the other output current.

The supply will operate from mains inputs of 240 volts 50/60Hz only. (Units to operate from 220 volts 50/60Hz can be supplied on request).

Since the 'H' series are physically heavy units and can be operated in several different modes, the following notes on installation and operation should be carefully read and understood before use.

INSTALLATION

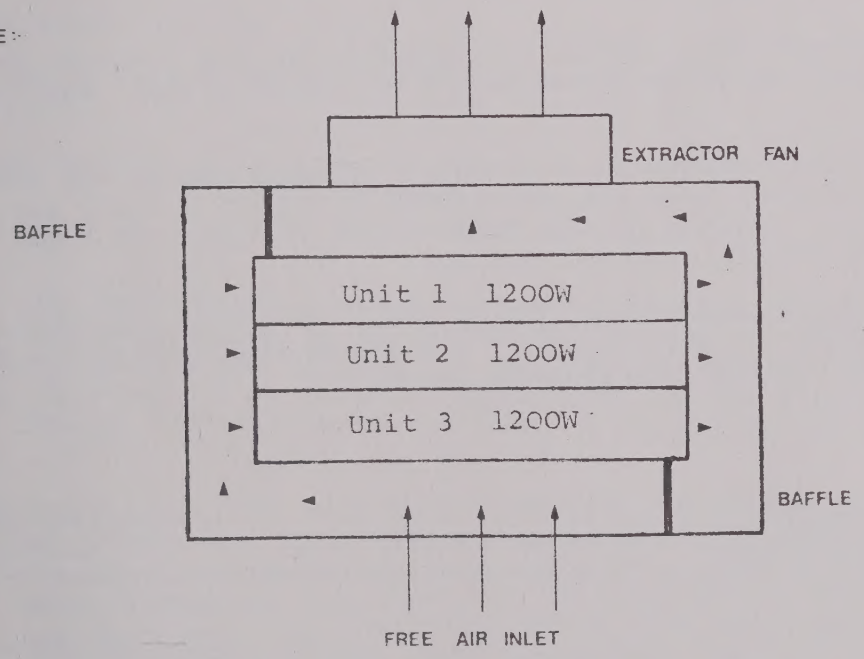
The weight of the unit is carried on its side panels and support runners should be provided directly under them, capable of supporting the weight of the unit. The front panel must not support any appreciable weight.

Units may be operated one on top of another without removing the covers.

As the units are cooled by forced air the construction of any cabinet into which the units may be fitted must allow adequate air intake and exit. Recirculation of air must be prevented by baffles (see fig. 1). At full current output, the power dissipated within the unit raises the temperature of the air passing through it by 20-30°C. Air intake is on one side of the unit and exit on the other.

Take the case of three H30/100's operating at full load in one cabinet. Air should enter and leave the cabinet at approximately 170 m^3/hour (100 cu. ft. per minute) and to do this, an additional fan in the cabinet would be necessary.

EXAMPLE:-



Dissipation per unit

H60/25	300w
H60/50	600w
H30/100	1200w

OPERATING INSTRUCTIONS

WARNING

Care should be taken to ensure that the mains input setting as indicated on the label on the rear of the unit is compatible with the intended input voltage.

Connection to the mains is by the studs on the rear of the unit marked L, N, E i.e. Mains live, Mains neutral, Earth. Units are normally supplied for 240 volts operation unless otherwise requested. As a filter is incorporated in the input circuitry, a good earth is essential.

Normal operation

At the rear of the unit, link terminals:-

(1) B, C and J
(2) D, E and F
(3) G, H and K

Connection to the load is via the studs on the rear of the unit marked 'O/P+' and 'O/P-'.

Output voltage and current are adjusted by the 'coarse' and 'fine' controls on the front panel marked 'Voltage adjust' and 'Current adjust'.

The unit will operate as a constant voltage source for load resistances greater than the resistance given by V set/I set, where V set is the setting of the unit output voltage and I set is the setting of the unit output current.

For load resistances less than V set/I set, the unit will operate as a constant current source. The changeover from constant voltage to constant current is automatic.

Thermal trip

The unit is protected against the effects of restricted air flow or fan failure and will automatically shut down if internal overheating occurs. Indication of shutdown is provided by the illumination of the lamp in the centre of the front panel. In order to reset the unit after shutdown (provided that the cause has been rectified) sufficient time should elapse for the unit to cool (approximately 3 minutes with the fans running) and the reset button on the front panel pressed and released. The unit will reset to correct operation.

Remote programming operation (resistive)

Units may be externally programmed in either constant voltage, constant current or both, by means of external resistors.

a) Constant voltage

Connection of the terminals at the rear of the unit is as follows:-

Link terminals (1) B, C and J
(2) D, E and F
(3) H and K

Turn the 'Voltage adjust' controls fully anticlockwise or short them out internally.

Connect the programming resistor between terminals G and K.

The programming coefficient is approximately 840Ω/volt for 30V units and 420Ω/volt for 60V units, but can be varied slightly by means of internal adjustment of the programming current source, trimmer P1 on the control amplifier circuit board.

N.B. Stable, low noise, low temperature coefficient resistors of at least ¼ watt rating should be used and connection from the unit to the programming resistor should be made via a twisted pair of wires.

b) Constant current

Connection of the terminals at the rear of the unit is as follows:-

Link terminals (1) B, C and J
(2) D and F
(3) G, H and K

Connect the programming resistor between terminals A and F. The programming coefficient is approximately 10Ω/amp for H30/100, 20Ω/amp for H60/50 and 40Ω/amp for H60/25, but can be varied slightly by means of an internal adjustment of the programming current source, trimmer P2 on the control amplifier circuit board.

N.B. Stable, low noise, low temperature coefficient resistors of at least ¼ watt rating should be used and connection from the unit to the programming resistor should be made via a twisted pair of wires.

Remote programming operation (voltage)

Units may be externally programmed in either constant current or constant voltage or both, by means of an externally applied voltage.

a) Constant current

At the rear of the unit link terminals as follows:-

(1) B, C and J
(2) D and E
(3) G, H and K

Turn current controls fully clockwise and use voltage controls normally. Connect the programme voltage between terminal B, positive, and negative via an external resistor to terminal D. The resistor should allow a maximum current of approximately 1mA which corresponds to maximum output current.

b) Constant voltage

At the rear of the unit link terminals as follows:-

(1) B, C and J
(2) D, E and F
(3) H and K

Turn voltage controls fully anticlockwise and use current controls normally. Connect the programme voltage negative to terminal B and positive via an external resistor to terminal G. The resistor should allow a maximum current of approximately 1mA for 30V units and 2mA for 60V units, and this corresponds to maximum output voltage. Also connect an external 27kΩ ½W resistor between terminals G and H and open circuit the flexible wire link between pins 12 and pin 4 on the control amplifier circuit board mounting socket accessible behind the unit's front panel.
N.B. Normal operation of the front panel voltage controls is not possible until the wire link between pins 12 and 4 is replaced.

Remote sensing (constant voltage only)

Where it is required to compensate for the voltage drop across the leads connecting the load to the unit i.e. maintaining a constant voltage at the load and not at the unit output terminals, use may be made of the remote sensing facilities.

Connection of the terminals at the rear of the unit is as follows:-

Link terminals (1) C and J
(2) D, E and F
(3) G and H

Connect terminal B to the positive output lead at the load, twisting the wire round the output lead.

Connect terminal G to the negative output lead at the load, twisting the wire round the output lead. An electrolytic capacitor of approximately 4000μF 60V WKG should be connected directly across the load in order to reduce overshoot and undershoot following transient load changes. It may be found necessary to decouple terminal B to the positive output terminal and terminal G to the negative output terminal, (to stop instability) at the unit with an electrolytic capacitor. The value of capacity required is indeterminate as it depends upon the conditions in the particular installation.

Since the resistance of the positive output lead is now in series with the current sensing resistor it will be found necessary to adjust P2 on the control amplifier circuit board so that with the 'CURRENT ADJUST' controls fully clockwise full output current can be obtained with the load short circuited.

Series operation

Units may be connected directly in series in order to give a greater voltage range. Output current capability will be determined by the supply set to the lowest current. It is recommended that no more than two supplies be connected in this manner.

Parallel operation

A master/slave configuration is used when a current greater than that available from a single supply is required.

Connection of the terminals at the rear of the unit is as follows:-

The master supply is connected as for a single supply (normal, or remotely programmed).

On the slave supply (ies)

Link terminals (1) A and D
(2) B and J
(3) G, H and K

Terminal C on the slave unit is connected to terminal A on the master unit.

Output voltage and current is controlled by the master supply only, provided that the 'VOLTAGE ADJUST' controls on the slave units are turned fully clockwise.

N.B. Since the voltage drop of the positive output lead from each supply is added to the current sensing voltage for each supply, the following method of connection for MASTER/SLAVE systems should be used.

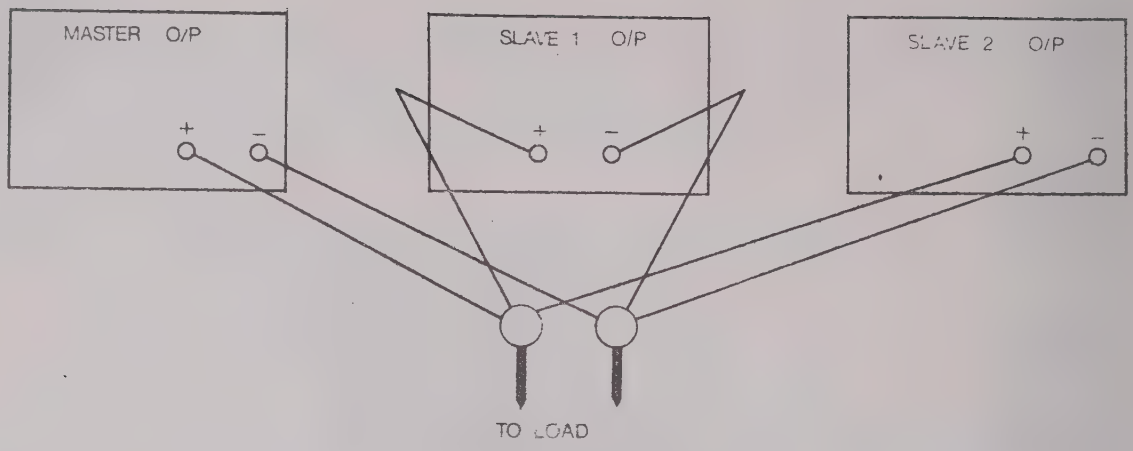
(1) The positive output lead from each unit should be taken to a common connection, as near to the units as possible. These leads should be of equal rating and equal length and as short as possible.

Similarly:-

(2) The negative output lead from each unit should be taken to a common connection, as near to the units as possible. These leads should be of equal rating and equal length and as short as possible.

(3) The load connection leads should be taken to the common positive and negative connections.

Current sharing should be checked by measuring the voltage across terminals A and B on each unit. The voltages should be equal to within 1%.



External meters

Connection to an external voltmeter should be made to terminals J and K when normal operation is used or across the load when remote sensing is used. (Terminal J is positive with respect to terminal K).

A signal of 0 to approximately 1 volt corresponding to 0-full load is available at terminals A and B (terminal A being positive with respect to B). Connection may be made from these terminals to a meter of 1mA full scale deflection, with suitable series resistance to provide a remote load current indication.

CIRCUIT DESCRIPTION

Basic principle

The function of the pre-regulator is to minimise the power dissipation in the series regulator by keeping the voltage across it constant under all output and input conditions.

Output current is monitored by the voltage across the current sensing resistor, and this signal is fed to the constant current amplifier. Any change in output current is detected, amplified and fed to the series regulator in such a sense as to oppose the original change.

Similarly, output voltage is sensed by the constant voltage amplifier and any change is amplified and fed to the series regulator in such a sense as to oppose the original change.

S.C.R. control

The control circuit consists of a pulse output stage feeding the S.C.R.s, which is driven by a high frequency oscillator which in turn is gated by a pulse width modulated signal from a comparator. This compares the signal from a further comparator with a ramp waveform which is synchronised to twice the supply frequency. The second comparator compares the separation voltage with an internal reference voltage.

A zero threshold switch R7, R8 and VT1 switches on VT2 every half cycle. C5 is charged via R13 until VT2 conducts and discharges C5, thus a ramp waveform of approx. 5V peak to peak appears across C5 synchronised to twice the supply frequency.

VT3, R23, R26 and Z6 form a constant current source feeding the reference zener Z5, this feeds the potential divider R6, P1 and R3. Half of IC1 compares the voltage at the junction of P1 and R3 with zero line via R5 and provides a proportional change in output at the cathode of D5. R1, R2, C1 and C2 form a compensating network for stability against a.c. ripple at the sensing point.

R11 and P2 form a d.c. potential divider providing a variable voltage at D9 which catches the control voltage from D5. The second comparator, which compares this voltage with the ramp waveform across C5, provides a variable mark/space ratio output signal at R17. P2 sets an upper voltage limit on the signal into the second comparator and this acts as a minimum mark limit. The output at R17 is limited at 5V by Z4 and fed to pin 1 of IC2 as an inhibit signal.

IC2 is a dual quad input nand Schmitt whose output at pin 6 is fed back via R18, R19 and D6 to an input at pin 2 and with C7 forms an oscillator at approx. 10kHz. The variable mark/space signal at pin 1 stops the oscillations during the space and therefore a burst of 10kHz square wave appears during the variable on time or mark. The remaining two inputs at pins 4 and 5 can inhibit the oscillator and thus switch the S.C.R.s off.

The output at pin 6 is inverted through the second gate (input at pin 9 and output pin 8) and fed via R21 to a further inverter

stage VT4. This drives VT5 via R25 and R24 and subsequently fires the S.C.R. gates via the pulse transformer T1.

The bridge rectifier MR1 is fed from the 6.5V winding on MT2, smoothed by C9 and is used as an auxiliary driver supply for VT1 on the driver assembly on the H30/100 only.

Auxiliary supply H30/100

Supplies for the control amplifier circuit board are derived from a 36-0-36 volt winding on MT2. This is rectified by diodes D1 and D2 and smoothed by capacitors C1 and C2. VT1, VT2, VT3, Z1 and associated resistors form a constant current source feeding zener diodes Z2 and Z3 giving a +15V-0--15V supply for the control amplifiers.

This circuit board also incorporates two thermal trip circuits, to monitor the regulator and rectifier heatsink assembly temperatures and shut down the supply if a dangerous temperature is reached. A warning lamp and reset button are provided on the front panel.

The dual OP-AMP IC1 is connected as two Schmitt triggers which sense between the zero line and the potential divider P3, R16, R15 and TH1. TH1 is connected between pins 17 and 13 and mounted on regulator heatsink assembly. TH2 connected between pins 16 and 11 is mounted on the rectifier heatsink assembly. The outputs of the two Schmitt triggers are summed at the base of VT4 and therefore VT4 turns on when a dangerous temperature is reached on either heatsink assembly. This causes SCR1 to conduct, lighting the warning lamp and feeding a shutdown signal via pin 7 to the control amplifiers. After the heatsink has cooled sufficiently to allow the Schmitt to reset, the unit may be reset by pressing and releasing the reset button connected between pins 5 and 7.

P1, R1 and P2, R2 are meter calibration resistors.

Auxiliary supply H60/50 & H60/25

Supplies for the control amplifier circuit board are derived from a 36-0-36 volt winding on MT2. This is rectified by diodes D11 and D12 and smoothed by capacitors C7 and C8. VT9, VT10, VT11, Z4 and associated resistors form a compound current source feeding zener diodes Z5 and Z6 giving a +15-0--15 volt supply for the control amplifiers.

Also on this circuit board is the thermal overload circuitry. This senses the regulator heatsink temperature via the thermistor mounted on the heatsink assembly and shuts down the supply if a dargerous temperature is reached. A warning lamp and reset button are provided and are situated in the centre of the front panel.

VT28 and VT29 form a Schmitt trigger which senses between the zero line and potential divider P6, R37, TH1 and R36 (TH1 being connected between pins 1 and 6). Normally VT28 is non-conducting but if a dangerous temperature is sensed then the Schmitt trigger

changes state and VT28 conducts. This causes SCR1 to conduct lighting the warning lamp and feeding a shutdown signal via pin 12 to the control amplifier. After the heatsink has cooled sufficiently to allow the Schmitt trigger to reset by pressing and releasing the reset button connected between pins 11 and 14.

P5, R80 and P12, R79 are meter calibration resistors.

Control amplifiers

These consist of the following:- (a) Voltage reference and constant voltage amplifier (b) Current reference and constant current amplifier (c) Shutdown and short circuit protection amplifier (D) Drive circuit.

(a) Voltage reference and C.V. amplifier

VT1, Z1, R1 and R3 comprise a constant current source feeding the reference zener Z2 and potential divider R4 and front panel potentiometers, P1 and P2. IC1 compares the voltage at the junction of R5 and P1 with the zero line, and produces an output change proportional to the original output voltage change. P3 is provided to offset the output of the comparator to obtain zero voltage output.

(b) Current reference and C.I. amplifier

VT5, Z4, R25 and R26 comprise a constant current source feeding the reference zener Z3 and potential divider R27, P2 and front panel potentiometers P3 and P4. IC2 compares the voltage at the junction of P2 and P3 with the voltage across the current sense resistor. Any change in output current causes a change in voltage across the sense resistor and the comparator produces an output change proportional to the original current change. P4 is provided to offset the output of the comparator to obtain zero current output.

(c) Shutdown and short circuit protection amplifier

This consists of IC3, VT3, VT4 and associated resistors. Pin 17 is connected to the unregulated d.c. line, pin 7 is connected to the anode of SCR1 in the thermal overload circuit, and pin 9 is connected to the positive end of the current sense resistor.

The output of IC3 at D4 is normally in such a condition as to not effect the operation of the C.V. and C.I. amplifiers at D3 and D5. If the separation voltage (i.e. across pins 13 and pin 17) exceeds approx. 20 volts, VT4 and VT3 cease to conduct and IC3 begins to reduce the output. As the separation voltage increases further the output current is reduced linearly to approx. 2A when the separation voltage reaches approx. 60 volts. This prevents 'second breakdown' failure of the series regulator transistors on applying a sudden short circuit to the unit output terminals.

If a thermal overload is detected, SCR1 (on the auxiliary supplies board) conducts and connects pin 7 to the -15V auxiliary line. This forward biases D6 and causes IC3 to feed a shutdown signal via D4, and no output can flow until the unit is reset.

(d) Drive circuit

The outputs of IC1, IC2 and IC3 are commoned through D3, D4 and D5 at the base of the emitter follower VT2, and the signal from its emitter is fed via pin 6 to the series regulator.

Series regulator H30/100

This consists of transistors VT1 to VT19. VT4 to VT19 are connected in two parallel banks of eight, each fed from the second emitter followers VT2 and VT3. The drive to VT2 and VT3 is commoned from the output at the emitter of VT1 which in turn is driven from pin 6 of the control amplifier board. VT1 in the series regulator circuit and VT2 on the control board are both supplied from a further low voltage auxiliary line from pins 1 and 2 of the SCR control board.

Series regulator H60/50

This consists of transistors VT30 to VT39, VT30 and VT31 being cascaded emitter followers driving the parallel connected emitter followers VT32 to VT39.

Series regulator H60/25

This consists of transistors VT30 to VT35, VT30 and VT31 being cascaded emitter followers driving the parallel connected emitter followers VT32 to VT35.

MAINTENANCE

The equipment supplied by Farnell Instruments Ltd., is guaranteed against defective material and faulty manufacture for a period of twelve months from the date of despatch. In the case of material or components employed in the equipment but not manufactured by us, we allow the customer the period of any guarantee extended to us.

The equipment has been carefully inspected and submitted to comprehensive tests at the factory prior to despatch. If, within the guarantee period, any defect is discovered in the equipment in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense subject to our standard conditions of sale. In exceptional circumstances and at the discretion of the Service Manager, a charge for labour and carriage costs incurred may be made.

Our responsibility is in all cases limited to the cost of making good the defect in the equipment itself. The guarantee does not extend to third parties, nor does it apply to defects caused by abnormal conditions of working, accident, misuse, neglect or wear and tear.

In the event of difficulty, or apparent circuit malfunction, it is advisable to telephone (or telex) the Service Department or your local Sales Engineer or Agent (if overseas) for advice before attempting repairs.

For repairs it is recommended that the complete unit be returned to:-

The Service Department,
Farnell Instruments Ltd.,
Sandbeck Way,
Wetherby, Yorkshire.
LS22 4DH

Tel: 0937 3541 Telex: 557294

or

Service Depot,
Farnell Instruments Ltd.,
Hermitage Road,
London N.4.

Tel: 01-802 5359

Please ensure adequate care is taken with packing and arrange insurance cover against transit damage or loss.

For those who operate their own comprehensive service department a section on 'Internal Adjustments' will be found on page 14.

INTERNAL ADJUSTMENTS

Mains input

Units are for operation at 240 volts input only. Special units can be manufactured for mains inputs of 220, 380 or 415V 50/60Hz.

WARNING

No attempt should be made to make any adjustments without strict reference to the following instructions, otherwise damage may result.

Meter calibration

(1) Voltmeter: With the unit giving 30 volts output on H30/100 or 60V on H60/50 or H60/25 (measured using an accurate external meter) adjust P2 on H30/100 or P12 on H60/50 or H60/25 (on the auxiliary supplies circuit board) until the front panel meter reads full scale.

(2) Ammeter: With the unit giving full output current (measured using an accurate external meter) adjust P1 on H30/100, or P5 on H60/50 or H60/25 (on the auxiliary supplies circuit board) until the front panel meter reads full scale.

Maximum output voltage

(1) With both 'VOLTAGE ADJUST' controls turned fully anticlockwise, adjust P3 (on the control amplifiers circuit board) until a positive output of less than 50mV is measured on an external meter.

(2) With both 'VOLTAGE ADJUST' controls turned fully clockwise, adjust P1 until an output of 30.5 volts on H30/100 or 60.5V on 60V models is measured using an external meter.

Maximum output current

(1) With both 'CURRENT ADJUST' controls turned fully anticlockwise, adjust P4 until a positive output current of less than 50mA is measured on an external meter.

(2) With both 'CURRENT ADJUST' controls turned fully clockwise, adjust P2 until a current of 101 amps on H30/100 or 50.5A or 25.25A on the 50A and 25A models is measured on an external meter.

Thermal overload (H30/100)

With the unit running at 100 amps output and thermocouple type thermometer probes attached to the regulator heatsink and rectifier heatsink (with top and bottom covers in place) block the air inlet and outlet vents. The warning lamp should light and the unit should shutdown when a temperature of approx. 100°C is measured on the rectifiers and 110°C on the regulators. If this is not so, adjust P3 and P4 on the auxiliary supplies board and repeat the operation after allowing 3-4 minutes off load running for cooling.

Thermal overload H60/50 & H60/25

With the unit running at full load current and a thermocouple type thermometer probe attached to the top regulator heatsink near the inlet fan (with top and bottom covers in place) block the air inlet and outlet vents. The warning lamp should light and the unit shutdown when a temperature of approximately 100°C is measured. If this is not so, adjust P6 on the auxiliary supplies board and repeat the operation after allowing 3-4 minutes off load running for cooling.

N.B. Should any further adjustments appear to be necessary all the following instructions should be carried out in the set sequence.

Separation voltage

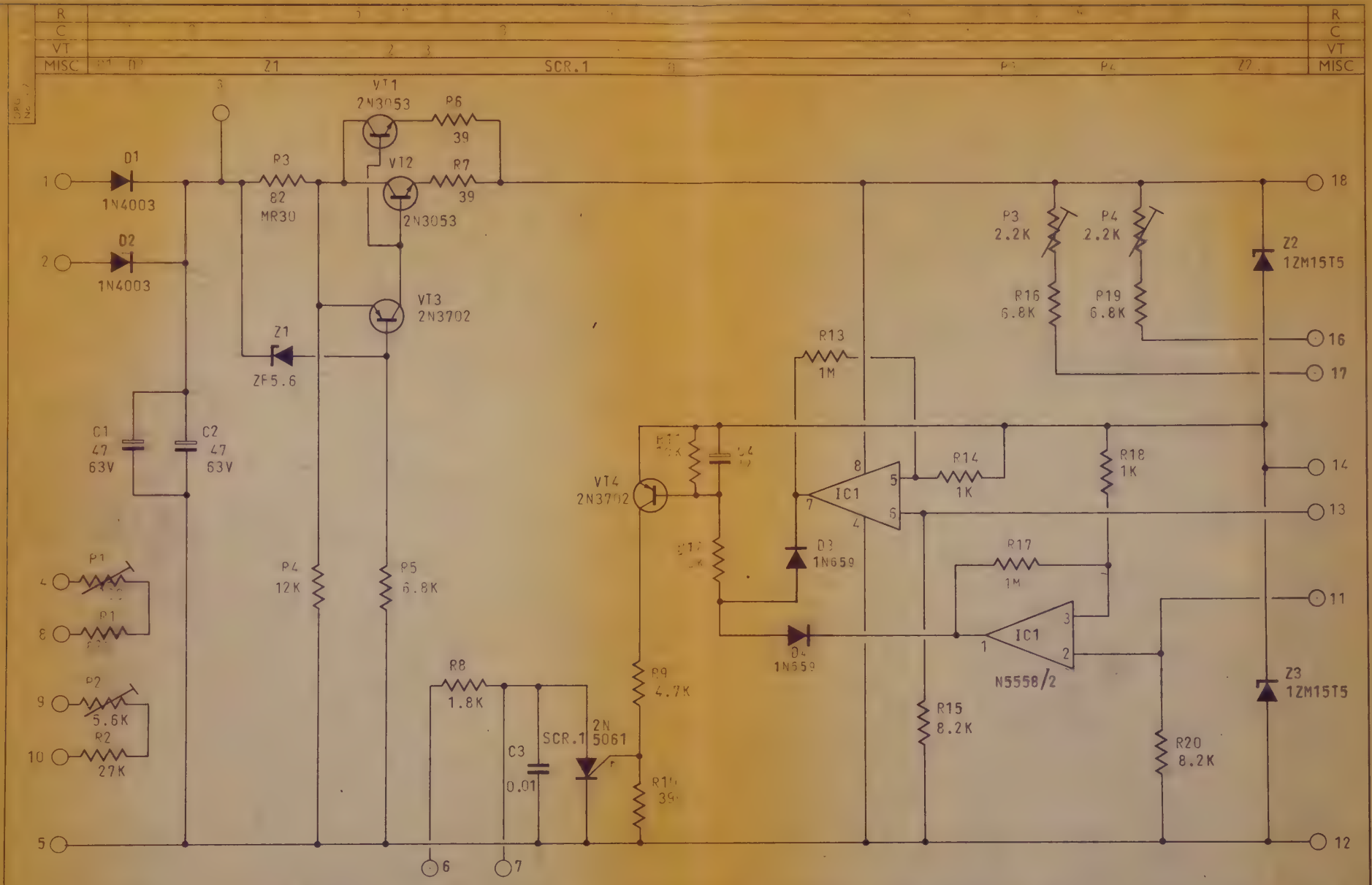
With the unit output terminals short circuited, turn the output current up from zero to full load. Connect a voltmeter across the reservoir capacitors and adjust P1 on SCR control board, to give 6.0 volts on the H30/100 model and 8.5V on the H60/50 and H60/25 models.

Short circuit protection

Disconnect the lead from pin 17 on the control amplifiers circuit board at its connection to the driver transistor. With the output terminals short circuited adjust the output current from zero to full load. Connect a 0-60 volt variable d.c. power supply (current is less than 5mA) between the positive output terminal and the disconnected wire. Slowly increase the voltage from the variable supply. At approximately 20 volts, output current should start to fall. Adjust P5 on the control amplifier circuit board so that the change in current is smooth and not a sudden step when varying the voltage about this point. Increase the voltage to 60 volts and adjust P6 to give an output current of less than 2 amp. Repeat the operation until no further improvement can be made. Remove the variable supply and reconnect the lead from pin 17.

N.B. All trimmers should be locked with a suitable compound after adjustment.

ERRATA & ADDENDUM



TRACED					
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DRAWN	M.H.	ISS. A	DATE 12·11·73	MOD. No.	

NOTE —
CAPACITOR VALUES GIVEN IN μF.
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD. PIN CONNECTION Nos.

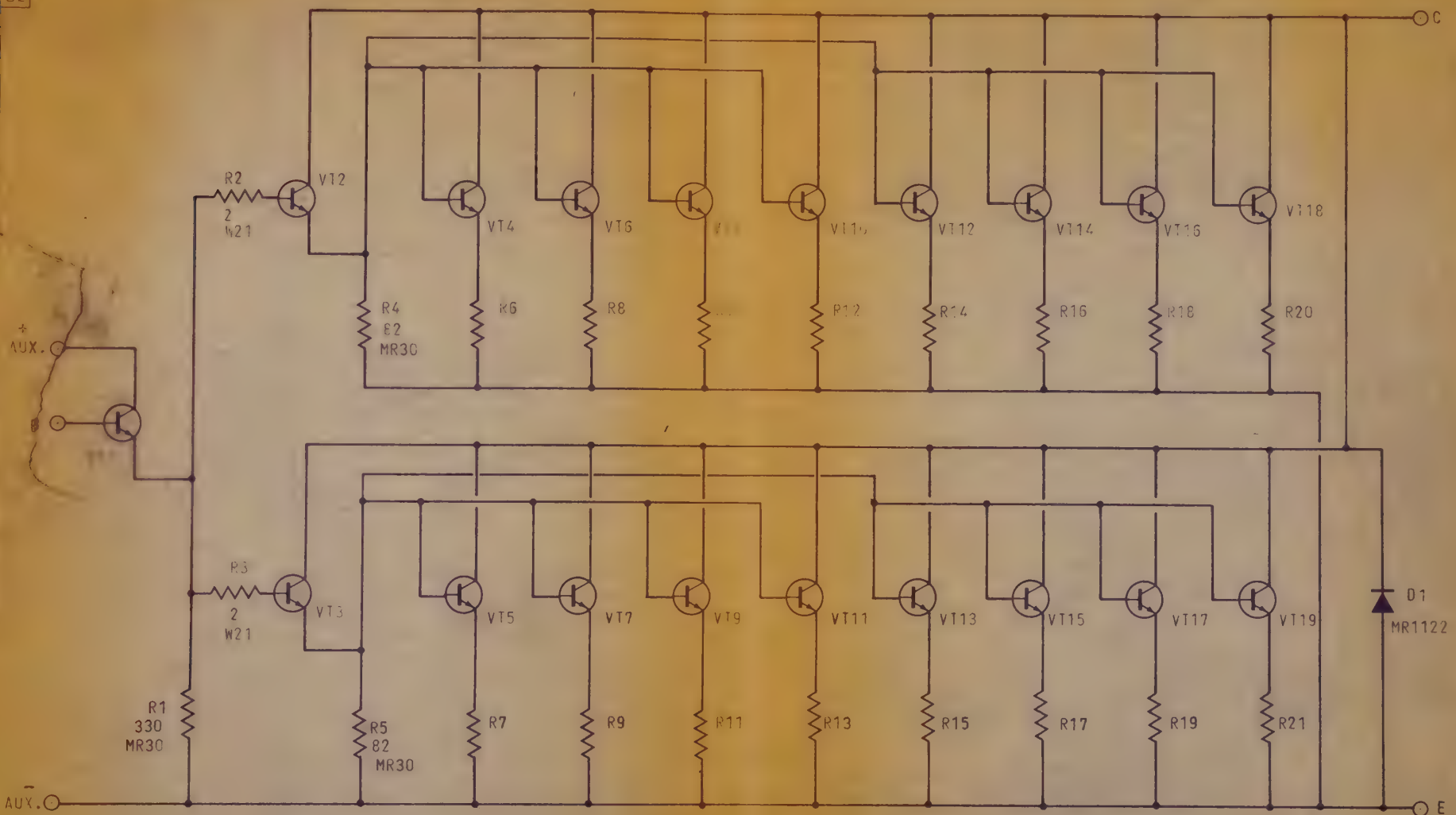
FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

AUX. SUPPLIES
CIRCUIT DIAGRAM H30/100

DRAWING No.
3 ZX 0642 103

R		2	3		5,	6,7,		8,9,						14,15.		16,17		18,19,	20,21		R
C																					C
VT		2,3,		4,5,		6,7,		8,9,			11		12,13,		14,15,		16,17,		18,19,		VT
MISC																					MISC

DRG No. 2 ZX 3...



ALL TRANSISTORS TYPE 2N3055 R6 – R21 TYPE 0.1 [illegible]

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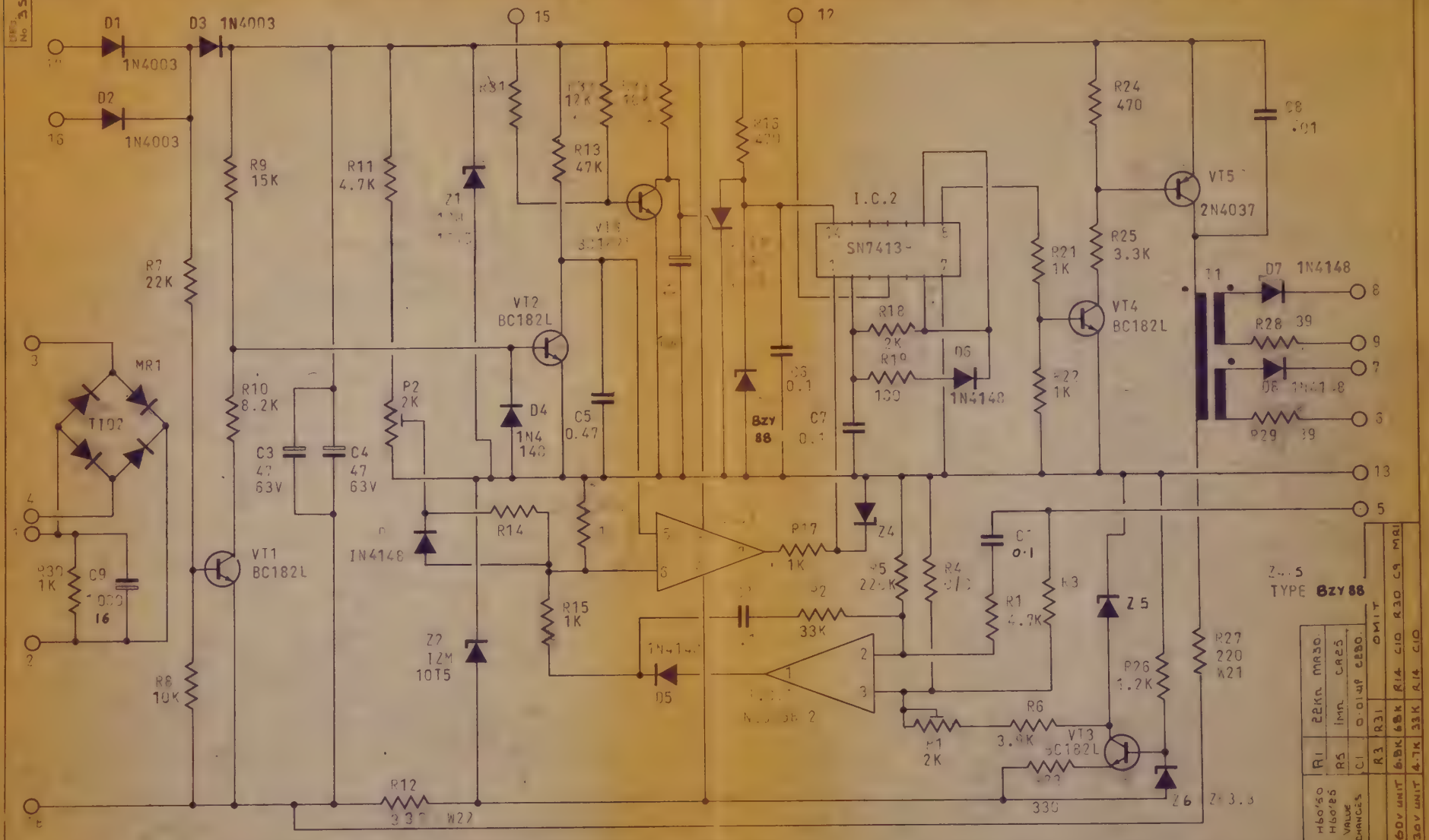
NOTE :—
CAPACITOR VALUES GIVEN IN μF.
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD. PIN CONNECTION Nos.

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

CIRCUIT DIAGRAM
SERIES REGULATOR. H30/100

DRAWING No.
3 ZX 0642 105

G.A.F. L/1735/50



TRACED		E	13-10-75	Q3596.							
CHECKED	P.G.	D	9-6-75	Q3409							
		C	15 1 75	Q3320							
DRAWN	M.H.	B	12.12.74	Q3278							
		ISS:	DATE	MOD. No.							
		A	23.9.74								

NOTE
CAPACITOR VALUES GIVEN IN μF.
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD. PIN CONNECTION Nos.

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

SCR.CONTROL CIRCUIT BOARD
CIRCUIT DIAGRAM.

DRAWING No.
3SZX0038

DRAWING No. 2ZX0642107

USED ON

| | | |

DRAWING No. 2SZX0037

USED ON

| | | |

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